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December 4, 2003

VIA ELECTRONIC FILING

Marlene H. Dortch
Secretary
Federal Communications Commission
445 Twelfth Street, S.W.
Washington, D.C. 20554

Re: Public Notice DA 03-3585; RM-10821

Dear Ms. Dortch:

Attached is a copy of the comments submitted on behalf of MariTEL, Inc. ("MariTEL") on December 1, 2003 in the above referenced proceedings.

As the date-stamped copy reflects, MariTEL filed its comments in paper -- not electronically -- with Federal Communications Commission ("FCC" or "Commission"). MariTEL's submission only included the relevant designated authority ("DA") number, but did not include the rulemaking ("RM") number. To ensure that FCC's record is complete and to correct this oversight, MariTEL is now submitting its comments electronically in the rulemaking RM-10821 docket.

Should you have any questions, please contact the undersigned.

Respectfully submitted,

/s/

Russell H. Fox
Susan F. Duarte

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF THE SECRETARY

In the Matter of	)	
	)	
Wireless Telecommunications Bureau	)	
Seeks Comment on MariTEL, Inc. Petition	)	
For Declaratory Ruling and National	)	**DA 03-3585**
Telecommunications and Information	)	
Administration Petition for Rulemaking	)	
Regarding the use of Maritime VHF	)	
Channels 87B and 88B	)	

COMMENTS OF MARITEL, INC.

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December 1, 2003

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SUMMARY

In this proceeding, the National Information and Telecommunications Administration ("NTIA"), on behalf of the United States Coast Guard ("USCG") asks that the Federal Communications Commission ("FCC") reallocate VHF Public Coast ("VPC") channels 87 and 88 exclusively for Automatic Identification System ("AIS") use. Except for incumbent, site specific licensees, MariTEL, Inc. ("MariTEL") is the exclusive licensee of channels 87 and 88 in maritime areas in the United States. NTIA requests reallocation of channels 87 and 88 because the USCG no longer views AIS as principally a mechanism for vessel traffic and collision avoidance. Instead, the USCG now intends AIS to be an important element of marine domain awareness. In fact, the USCG adopted rules, over MariTEL's objection, requiring carriage of AIS transmitters that employ MariTEL's channels 87 and 88 on a default basis.

MariTEL and the USCG had entered into a Memorandum of Agreement ("MOA") that allowed the USCG to use VHF channels 87A/B. The MOA subsequently was terminated because the USCG breached provisions of the agreement. The parties were unable to reach a new agreement regarding that, or any other, channel. Accordingly, NTIA submitted its request because the USCG and other Federal entities no longer have access to channel 87 and, as MariTEL has pointed out elsewhere, channel 88 in certain areas of the county. However, in order to grant the NTIA Petition, the FCC would be required to strip MariTEL of the rights obtained as the high bidder of VPC licenses in Auction 20.

NTIA's request should not be granted because it has failed to demonstrate why the USCG's needs for AIS channels cannot be addressed in the manner already adopted by the FCC in Section 80.371 of its rules. Although the uses for AIS may have expanded, AIS systems continue to function as the USCG always anticipated. There is no reason, therefore, that the FCC should abandon its past decision in favor of an approach it already rejected. Therefore, the FCC should order the USCG to re-enter negotiations with MariTEL

If the FCC adopts NTIA's Petition, it would establish a dangerous precedent that would allow the FCC to change the rules affecting the value of auctioned spectrum after licenses are issued. Such a precedent would have a chilling effect on future auctions and investment in spectrum assets. Moreover, reallocation of channels 87B and 88B constitutes an unconstitutional taking of MariTEL's spectrum assets (not limited only to channels 87 and 88, because of interference to MariTEL's other channels) for which the FCC must compensate MariTEL. One method of compensation, providing replacement spectrum dedicated for government use when there is a critical government need is consistent with past FCC practices. However, the NTIA has not acted in this case consistently with other instances where replacement spectrum was provided to licensees displaced because of national security interests. In addition, before the FCC can adopt the NTIA Petition, it must address many open questions regarding the "shared" use of channels 87 and 88. MariTEL has suggested a means by which it can remain the licensee of channels 87 and 88 and allow the USCG to meet its requirement to use those channels for AIS. In particular, MariTEL has recommended that the FCC designate it as the recognized frequency coordinator for channels 87 and 88.

Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, D.C. 20554

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Telecommunications and Information	**)**	
Administration Petition for Rulemaking	**)**	
Regarding the use of Maritime VHF	**)**	
Channels 87B and 88B	**)**	

COMMENTS OF MARITEL, INC.

MariTEL, Inc., by its attorneys and pursuant to the invitation extended by the Federal Communications Commission ("FCC" or "Commission") in the Public Notice issued on November 7, 2003 ("Public Notice"),[1/] hereby submits its comments responsive to the petition for rule making submitted by the National Telecommunications and Information Administration ("NTIA") to the FCC on October 24, 2003 (the "NTIA Petition"). The NTIA Petition asks that the FCC allocate VHF channels 87B (161.975 MHz) and 88B (162.025 MHz) exclusively for Automatic Identification System ("AIS") use by both Federal government and non-Federal government entities on a shared basis nationwide.[2/] The NTIA Petition requests, in an

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1/ *Wireless Telecommunications Bureau Seeks Comments on MariTEL, Inc. Petition for Declaratory Ruling and National Telecommunications and Information Administration Petition for Rulemaking Regarding the Use of Maritime VHF Channels 87B and 88B*, DA 03-3585 (rel. Nov. 7, 2003).

2/ Although the Public Notice seeks comments on both the NTIA Petition and an Emergency Petition for Declaratory Ruling ("Emergency Petition") and Supplement thereto ("Emergency Petition Supplement") submitted by MariTEL, these Comments are restricted to the NTIA Petition. *See* Letter to John B. Muleta, Chief, Wireless Telecommunications Bureau, Federal Communications Commission from Frederick R. Wentland, Association Administrator, Office of Spectrum Management, National Telecommunication and Information Administration (filed Oct. 24, 2003) ("NTIA Petition"). MariTEL will address any comments to its Emergency Petition and Emergency Petition Supplement on or before December 11, 2003, the deadline for

unprecedented manner, that the FCC strip MariTEL of its rights as a winner of FCC auctioned licenses. MariTEL therefore opposes the NTIA Petition.

I. Introduction

A. MariTEL

MariTEL was the largest provider of VHF Public Coast ("VPC") services in the United States and, through various predecessors in interest, provided ship-to-shore services for over forty (40) years.[3/] In 1999 and again in 2001, MariTEL actively participated in the FCC's auctions of VPC station licenses.[4/] As a result, MariTEL became the exclusive entity (except for site-specific incumbent licensees) authorized to operate maritime VPC spectrum. Among the channels for which MariTEL is licensed are channels 87 and 88.

B. AIS

The NTIA Petition asks that the FCC designate the use of VHF channels 87B and 88B exclusively for AIS use on a shared Federal government non-Federal government basis. As the FCC is aware, AIS is a system designed to permit ship-to-ship, shore-to-ship, and ship-to-shore

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the submission of reply comments responsive to the *Public Notice*, or in subsequent permitted *ex parte* communications to the FCC.

3/ As MariTEL notified the FCC, it terminated its provision of voice communications services on June 6, 2003. *See Wireless Telecommunications Bureau Seeks Comment on MariTEL, Inc. Request to Extend Construction Deadline for Certain VHF Public Coast Station Geographic Area Licenses*, DA 03-1484, released May 5, 2003 ("MariTEL Extension Request") (referencing FCC File Nos. 0001252148, 0001252177, 0001252257, 0001252325, 0001252214, 0001252280, 0001252315 and 0001252335). The MariTEL Extension Request outlines MariTEL's future plans for the use of its licensed spectrum. MariTEL does not reiterate those plans here but asks that its description of future plans provided in the Extension Request be incorporated herein by reference.

4/ "FCC Announces the Conditional Grant of 26 VHF Public Coast Station Licenses," *Public Notice*, DA 99-195, 1999 FCC LEXIS 2251 (rel. May 21, 1999) (announcing that MariTEL was the winning bidder of nine VHF public coast licenses); "VHF Public Coast and Location and Monitoring Service Spectrum Auction Closes: Winning Bidders Announced," *Public Notice*, DA 01-1443 (rel. June 15, 2001) (announcing that MariTEL was the winning bidder of seven inland VPC licenses).

communications in support of, among other things, vessel traffic services and vessel collision avoidance.[5/] AIS is simply a communications tool and may be used for a variety of purposes. Initially, the United States Coast Guard ("USCG"), NTIA, and the FCC envisioned that VPC spectrum to support AIS would be employed exclusively as a part of its Ports and Waterways Safety System ("PAWSS").[6/]

The USCG Petition for Rule Making, submitted in 1997 stated that the USCG envisioned that AIS channels would be used in a duplex mode with 12.5 kHz wide channels. The USCG Petition for Rule Making also did not request dedicated VPC channels for AIS operations, contemplating that AIS traffic, such as those from foreign flag vessels, would be "switched" once the vessel entered U.S. waters. The FCC recognized PAWSS as the basis for the USCG's use of AIS technology in its *Third Report and Order*, with the operational parameters (12.5 kHz wide channels, duplex operations, and the ability to "switch" traffic from one channel to another).[7/]

Later, the USCG, as directed by Congress in November 2002, determined that AIS should be used in support of marine domain awareness, a component of its homeland security

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5/ *See Amendment of the Commission's Rules Concerning Maritime Communications*, PR Docket 92-257, *Third Report and Order and Memorandum Opinion and Order,* 13 FCC Rcd 19853 ¶¶ 46, 47 (1998) ("Third Report and Order"); *see also Amendment of Parts 13 and 80 of the Commission's Rules Concerning Maritime Communications*, WT Docket No. 00-48, *Report and Order and Further Notice of Proposed Rule Making*, 17 FCC Rcd 6741 ¶ 56 (2002); *see also Public Notice* n.2.

6/ Petition for Rule Making, submitted by the United States Coast Guard, August 4, 1997 ("USCG Petition for Rule Making"); *see also Notice of Public Meeting*, "Office of Vessel Traffic Management," United States Coast Guard, 63 FR 24837 (1998) ("The PAWSS project is based on a VTS that uses the automatic identification system"). The FCC envisioned that auctioned VPC spectrum would be employed for ship-to-shore communications in PAWSS areas, while channel 228B would be used nationwide for ship-to-ship communications. *Third Report and Order* ¶ 46.

7/ *Third Report and Order* ¶ 46.

efforts, instead of only supporting the PAWSS program's vessel traffic services and collision avoidance applications.[8/] MariTEL participated in the USCG's development of rules regarding the mandatory carriage of AIS transmitters that employ its channels 87B and 88B on a default basis. MariTEL's comments notwithstanding, the USCG adopted rules requiring carriage of AIS transmitters.[9/] The USCG now also states that instead of using AIS in a duplex mode, with narrowband channels, it must use AIS with simplex operations on wideband channels.[10/] Finally, instead of asserting that no specific channel need be designated for AIS, the USCG now states that designated channels are necessary because it is unsafe and risky to switch traffic, particularly from foreign vessels that enter United States waterways.[11/]

However, while the anticipated use and desired USCG configuration of AIS systems has changed dramatically, the internationally recognized methods by which AIS systems are expected to operate have remained comparably constant. ITU-R 1371 and IEC 61993 have been, and remain the applicable international standards for the operation of AIS systems.[12/] As the

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8/ *See* "Area Maritime Security," 68 Fed. Reg. 39284 (July 1, 2003); *see also* The Maritime Transportation Security Act, P.L. 107-295 § 70114 (2002).

9/ "Automatic Identification System; Vessel Carriage Requirement," 68 Fed. Reg. 60559, 60563 (2003). MariTEL has challenged the USCG's adoption of those final rules because, *inter alia*, they improperly strip MariTEL of any rights to use channels for which it is the FCC licensee. *See* MariTEL Inc. v. Admiral Thomas H. Collins and United States Coast Guard, Civil Action No. 1:03CV02418, (U.S.D.C. filed 11/21/2003).

10/ NTIA Petition at 2, 3.

11/ NTIA Petition at 4. The USCG's position regarding whether it is safe to switch AIS traffic from channels 87B and 88B is inconsistent at best. On the one hand, in its Final AIS Rules, the USCG stated that it could switch AIS traffic from channels 87B and 88B if those frequencies were not available domestically for AIS. On the other hand, the NTIA Petition states that switching AIS traffic is unsafe and risky.

12/ Technical Characteristics for a Universal Shipborne Automatic Identification System Using Time Division Multiple Access in the VHF Maritime Mobile Band, International Telecommunications Regulation ("ITU-R") M. 1371-1 (Aug. 1, 2001); Maritime Navigation and Radiocommunication Equipment and Systems – Part 1: Shipborne Automatic Transponder System Installation Using VHF Digital Selective Calling (DSC) Techniques – Operational and

FCC noted in the *Third Report and Order*, these technical standards have always envisioned that AIS transmissions would occur, in the default mode, on a simplex basis using channels 87B and 88B with 25 kHz wide channels in international waters but that the USCG (as the internationally recognized competent authority for the United States) would have the capacity to safely switch traffic to other channels and modes of operation within territorial waters.[13/] This core capacity of ITU-R 1371-1 has not changed nor is it considered to be unsafe within the international maritime community. To the contrary, the European Commission Decision on AIS identifies channels 87B and 88B as the ITU-R designated AIS channels but clarifies that "[o]ther frequencies allocated for marine communication may be available to the AIS."[14/] Additionally, the technical advantages of operating AIS on a wideband (as opposed to a narrowband channel) have not changed. It has always been recognized that wideband operations have a range and capacity advantage over 12.5 kHz channel operations in similar modes of operation. Therefore, the original USCG plans to use 12.5 kHz wide channels on a duplex basis, and "switch" channels when vessels entered United States waters were made with full knowledge of the international designation of AIS channels and the method by which they would be used internationally.

Performance Requirements, Methods of Testing and Required Test Results, IEC Standard 61993-1 (April 1999). Subsequent updates to Maritime navigation and radiocommunications equipment and systems - Automatic identification systems (AIS) - Part 2: Class A Shipborne Equipment of the Universal Automatic Identification System (AIS) - Operational and Performance Requirements, Methods of Test and Required Test Results, IEC Standard 61993-2 (December, 2001), did not materially alter the transmission characteristics of AIS equipment.

13/ *Third Report and Order* ¶¶ 47, 49 n.157.

14/ Commission Decision on the Application of Article 3(3)(e) of Directive 199/5/EC of the European Parliament and of the Council to Radio Equipment Intended to be Used on Non-Solas Vessels and Which is Intended To Participate in the Automatic Identification System (AIS), 03/808, art. 3(3)(e), 2003 O.J. (L 81/46) 1.

Accordingly, it appears that the USCG's changed need for AIS configuration is not due to changes in international policies and procedures – those policies and procedures have remained constant. Instead, at least a part of this change is attributable to the increased emphasis on marine domain awareness that the USCG now envisions for AIS.

There are many AIS configurations that allow effective tracking of vessels in and beyond U.S. territorial waters. However, the increased scrutiny on MDA and the USCG's implementation of vessel carriage requirements in advance of a supporting shore station infrastructure have created new pressures not envisioned by previous FCC decisions.

C. Memorandum Opinion and Order and Federal Use of Channels 87B and 88B

The other principal reason (besides the USCG's change in its planned use of AIS) that NTIA submitted the NTIA Petition is NTIA's lack of spectrum assets to support AIS. As the Commission is aware, the *Third Report and Order* mandated that MariTEL (as the VPC licensee of all maritime VPC regions) negotiate with the USCG for the USCG's use of up to two narrowband, offset channel pairs for use in support of PAWSS (although the USCG may have intended for the channels to be used with AIS technology, the FCC's decision and regulations only note its employment in the PAWSS program).[15/] The FCC's decision regarding the method by which the USCG would satisfy its spectrum needs for PAWSS was codified at 47 U.S.C. 80.371(c)(3).[16/]

Consistent with the FCC's *Third Report and Order* and the requirements of Section 80.371 of its rules, MariTEL and the USCG elected to enter into a Memorandum of Agreement

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15/ *Third Report and Order* ¶ 49.

16/ 47 C.F.R. § 80.371(c)(3) (2003).

("MOA")[17/] to provide the USCG with the use of VPC spectrum for use in PAWSS. In particular, the MOA permitted the USCG to use channels 87A/B to support PAWSS operations. Consistent with the USCG's statements regarding AIS and the FCC's rules and decisions, the MOA was designed to permit the USCG to employ these channels on a narrowband basis (12.5 kHz), for duplex operations, and in a manner that required the USCG to switch traffic from the channels when vessels entered PAWSS areas.[18/] Absent the MOA, neither the USCG nor any Federal government entity had any rights to use these frequencies. The MOA was negotiated and executed under the premises initially established by the Coast Guard Petition and confirmed by the *Third Report and Order*, and prior to the USCG's determination that AIS technology would be used in a more extensive manner for vessel surveillance and tracking to support new marine domain awareness initiatives, with the corresponding technological departures from its initial PAWSS based system.

While the MOA was in effect, and apparently after the USCG determined to use AIS in support of marine domain awareness, the USCG notified the Wireless Telecommunications Bureau (the "Bureau") that the NTIA had approved the Coast Guard's use of VHF channels 87B and 88B on a nationwide basis for AIS.[19/] It asked that the FCC permit "other users of shipborne AIS equipment to operate on these frequencies for interoperability with the US Coast Guard."[20/]

17/ The vehicle of an MOA was chosen by the USCG to define each party's responsibilities to implement the agreement required by Section 80.371 of the FCC's rules. The MOA form was not mandated as the method to employ such an agreement.

18/ At the time the MOA was negotiated there was no international channels designation for the narrowband use of channel 87B. Subsequently the ITU created designations for 12.5 kHz wide channels and identified 487 as the use of channel 87B on a 12.5 kHz basis.

19/ Letter from J. Hershey, Chief, Spectrum Management Division, United States Coast Guard, to Thomas Sugrue, Chief, Wireless Telecommunications Bureau, Federal Communications Commission (dated May 6, 2002).

20/ *Id.*

In response, the Bureau issued a public notice, which permitted the use of shipborne AIS equipment to be employed by existing ship station licensees, "including vessels that are licensed by rule."[21/] A subsequent public notice announced procedures pursuant to which shipborne AIS equipment could be authorized.[22/] None of these Coast Guard requests, or the FCC's responses, suggested that the USCG planned to deviate from its intention to switch vessels to narrowband duplex operations as they entered PAWSS areas. The USCG did not inform MariTEL of their desire not to switch mariners until a meeting between MariTEL and USCG representatives on December 12, 2002.

Despite MariTEL's significant efforts, MariTEL and the USCG were unable to agree on implementation of the MOA in a manner that met the USCG's new desired configuration to operate AIS with a greater emphasis on vessel tracking and surveillance to enhance marine domain awareness. Accordingly, on May 5, 2003, MariTEL, pursuant to its authority under the terms of the MOA, terminated the MOA based on its belief that the USCG's had breached, without cure, several provisions of the MOA.[23/] Although the parties tried to negotiate new terms for the MOA, they have been unable to reach a consensus on how the USCG can expand its use of the spectrum without destroying MariTEL's ability to use the spectrum.[24/] Now that

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21/ "Wireless Telecommunications Bureau Announces Use of An Additional Frequency for the United States Coast Guard's Ports and Waterways Safety System," *Public Notice*, DA 02-1362 (rel. June 13, 2002) ("*June 13 Public Notice*").

22/ "Applications for Equipment Authorization of Universal Shipborne Automatic Identification Systems To be Coordinated with U.S. Coast Guard to Ensure Homeland Security," *Public Notice*, DA 02-1499 (rel. June 27, 2002).

23/ MariTEL asserted that the USCG breached Sections V B 5, 6, 7, 8, Sections VI A, B, C, and Section 7B of the MOA.

24/ MariTEL acknowledges that it is required to make spectrum available to the Coast Guard for use in the PAWSS. 47 C.F.R. § 80.371(c)(3). MariTEL has tried on several occasions to offer the Coast Guard a portion of its spectrum. The Coast Guard has consistently asked for more from MariTEL than is required under the Commission's rules. In addition, the Coast

the MOA is terminated, the USCG's (or any other entity whose rights are derivative of those granted to the USCG) rights to use this spectrum have expired.[25/]

Accordingly, the basis of the NTIA Petition is to obtain the use of channels to which the USCG (and any other Federal government entities) does not currently have access and in a manner that neither the FCC nor the USCG (or MariTEL as a party to the MOA) ever contemplated. MariTEL is the FCC licensee of those channels.[26/] To accept the NTIA Petition, the FCC must strip MariTEL of the rights it obtained as the high bidder of the VPC licenses in Auction 20. NTIA does not propose any relief to MariTEL for this unprecedented act nor does the NTIA Petition contain any relevant details regarding the "sharing" of channels 87B and 88B between Federal government and non-Federal government entities. Accordingly, MariTEL is pleased to have the opportunity to submit these comments opposing the NTIA Petition.

Guard has walked away from the parties' negotiations and has failed to cooperate with MariTEL to reach a solution.

[25/] MariTEL has permitted the Coast Guard to continue to use channel 87 at the four PAWSS locations (Sault Ste Marie, Lower Mississippi River, Prince William Sound, and Berwick Bay) where it believed channel 87 was in operation as of June 4, 2003, so as not to disrupt current operations. No other continued use of channel 87 was permitted. The USCG and MariTEL disagree on the precise date on which any rights the USCG has to use channel 87 ends (MariTEL believes that such authority ended on November 5, 2003 and the USCG suggests that its authority ends on December 5, 2003). Even if the USCG is correct, by the time that the deadline for the submission of reply comments in this proceeding passes, it will be uncontroverted that the USCG has no rights to use channel 87.

[26/] Although the MOA covered only channel 87, the NTIA Petition also seeks use of channel 88B. The NTIA erroneously asserts that it already has authority to employ channel 88. However, as MariTEL pointed out in its Petition for Declaratory Ruling, *see* Wireless Telecommunications Bureau Seeks Comment On MariTEL, Inc. Petition For Declaratory Ruling Regarding the Use of Maritime VHF Channel 88, *Public Notice*, 18 FCC Rcd 13177 (2003), the USCG does not have authority to operate on channel 88 in areas adjacent to the Canadian border. MariTEL expects that the FCC will resolve matters related to channel 88 in the context of its resolution of the NTIA Petition, if not before.

II. Discussion

A. There is no Basis for Grant of the NTIA Request

1. The NTIA's Request is Outside the Framework of Section 80.371 of the FCC's Rules and Requests the FCC to Reconsider the Precise Proposal Already Rejected by the FCC

NTIA suggests that FCC action is appropriate because the Commission's rules and decisions provide that if the VPC licensee and the USCG cannot agree on the channels to be designated for USCG operations, then the USCG can ask the FCC to select the channels to be used.[27/] However, the NTIA Petition cannot be considered a request contemplated by the FCC's rules and decisions. Section 80.371 of the FCC's rules provides that VPC licensees and the USCG are required to negotiate for USCG use of "up to two narrowband offset channels" and provides that if negotiations fail, that the USCG "may petition the Commission to select the channel pairs." However, the "channel pairs" that the FCC may select if VPC licensees and the USCG do not agree are the narrowband offset channels interleaved between the VPC 25kHz channel pairs that are referenced in the rules. Moreover, Section 80.371 of the rules envisions the USCG's use of those narrowband channel pairs on a duplex rather than on a simplex basis. Therefore, the NTIA's suggestion that its request is a natural outgrowth of the FCC's current rules and policies is incorrect and should cause the Commission to dismiss the NTIA request.

If the NTIA Petition is not considered to be within the context of the FCC's rules and policies adopted in the *Third Report and Order*, then it can only be considered a request to revisit a proposal that the Commission already considered and rejected in the *Third Report and Order*. However, NTIA has not demonstrated why the FCC's decision in the *Third Report and Order* to reject this plan was incorrect, or why circumstances have changed in a manner that makes the

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27/ NTIA Petition at 4.

FCC's prior determination invalid. In fact, as MariTEL demonstrates below, the circumstances that caused the FCC to reject the use of channels 87B and 88B for AIS are more compelling today then when the FCC rejected the proposal in the first instance.[28/]

Granting the NTIA request would, therefore, constitute a change in the rules of a service in which licensees were acquired at auction. However, the value bidders assigned to spectrum was based on the FCC's rules in place at the time. A modification to the rules now would constitute a revaluing of already auctioned spectrum. In addition to being plainly inequitable, grant of the NTIA Petition would establish a dangerous precedent, allowing the FCC to materially negatively change the rules affecting the value of auctioned spectrum after licenses are issued. Such a precedent would have a chilling effect on future auctions and investment in spectrum assets.

In determining not to designate 87B as an AIS channel, the FCC cited among other things: 1) the impact to incumbent VHF users; 2) the fact that designating one broadband channel for USCG use would encumber three narrowband channels and one broadband channel licensed to VPC operators; and 3) the fact that assignment of channel 87B for USCG use would harm a VPC license's ability to construct wide-area systems. The FCC's rationale for not assigning 87B is still valid today and the NTIA Petition provides no justification for why the FCC should find that its earlier decisions were invalid. Moreover, as MariTEL demonstrates

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[28/] The NTIA Petition also infers that this solution should be adopted because it represents a solution to which MariTEL agreed in the MOA. The NTIA's assertions and those of the USCG upon which it relies, are simply incorrect. MariTEL never agreed to make channel 87B available on a wideband duplex basis. As noted above, it was the USCG's initial plan to use channel 87A/B on a narrowband, duplex basis and the FCC's rules recognize this plan. It was only after the tragedy of September 11, 2001 – six months after the MOA was signed – that the USCG's mission to use AIS in support of marine domain awareness changed its desired configuration of an AIS network. Regardless of any alleged prior understanding of the MOA, MariTEL has terminated – as is its right under provisions of the MOA inserted by the USCG – the MOA based on its current understanding of how the USCG wished to implement the MOA.

below, the effects of the potential use of channel 87B on a simplex basis by the USCG are more destructive than the FCC originally contemplated.

2. The Coast Guard's Needs Can be Met Within the Framework of Current FCC Rules

The premise of the NTIA's request is that the USCG has a need for spectrum so that mariners (and the USCG) can most effectively operate AIS systems in support of marine domain awareness, collision avoidance and vessel traffic services. As demonstrated above, the NTIA Petition is beyond the scope of current Commission rules and decisions and represents a path already rejected by the FCC. However, there is no reason that the USCG requirements cannot be satisfied within the context of Section 80.371 of the FCC's rules. For example, MariTEL expects that one reason that the USCG prefers its proposed approach, as opposed to negotiations under Section 80.371 of the rules is because its approach will enable the USCG to detect transmissions further from shore. However, the Section 80.371 framework allows the USCG to achieve all relevant AIS applications including the "extended" surveillance capabilities required for homeland security. Moreover, the Section 80.371 framework can be augmented by the USCG not transmitting on channel 88B and listening to faint transmissions from vessels in international waters beyond the USCG's control of AIS frequencies. There are many other configurations that are also available within the context of the current rules, which if negotiated, could eliminate the need to consider the NTIA Petition.

The NTIA Petition includes many references to the MOA and how the termination of the MOA has caused it to seek relief in this forum.[29/] The NTIA and USCG apparently continue to believe that USCG and other Federal government requirements could have been met under an interpretation of the MOA. Therefore, it is not clear why the USCG has decided to abandon the

29/ NTIA Petition at 2-3, n.9, 4.

path established by the *Third Report and Order* and Section 80.371 of the FCC's rules. That path permits the USCG to obtain use of spectrum for AIS purposes to satisfy the USCG's needs for collision avoidance, vessel traffic services, and marine domain awareness. The USCG has yet to demonstrate why the framework of 80.371 is unable to support these applications. Therefore, the FCC should reject the NTIA Petition and instead direct the USCG to re-enter negotiations with MariTEL, as the rules already provide to meet their desire for their expanded needs. Even if the USCG's needs cannot be accommodated under the provisions of Section 80.371, the USCG has not demonstrated why it is unable to reach an agreement driven by market forces[30/] with MariTEL to satisfy its requirements. The FCC has already waived its regulations once to permit MariTEL and USCG to enter into an agreement that was not in strict accordance with the provisions of Section 80.371 of the rules.[31/] MariTEL expects that, in the interest of satisfying the USCG's requirements, the FCC would waive its regulations again to permit it and the USCG to enter into an agreement that does not strictly conform to the provisions of Section 80.371 of the regulations.[32/]

B. If the FCC Changes its Regulations Pursuant to the NTIA Petition, it will have a Severe Impact on MariTEL

If the FCC proceeds outside the parameters of Section 80.371, then reallocation of channels 87B and 88B constitutes an unprecedented taking of MariTEL's spectrum assets which

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30/ Those market forces must consider a variety of alternatives of frequency configurations, infrastructure, and modes of operations that yield various cost-benefit analyses. The USCG has already acknowledged that alternative configurations may save time and money.

31/ "Wireless Telecommunications Bureau Announces the Selection of Two VHF Channel Pairs for the United States Coast Guard's Ports and Waterways Safety System, *Public Notice*, 16 FCC Rcd 7968 (2003).

32/ MariTEL has already provide the USCG with several proposed solutions to the USCG's spectrum requirements. The USCG has not afforded serious consideration to any of these proposals.

it acquired for consideration from the FCC through participation the FCC's auction process. Any rules change by the FCC based on the NTIA Petition would also create questions about the potential future use of this valuable maritime spectrum. The federal courts have recognized that "when an owner . . . has been called upon to sacrifice all *economically* beneficial uses in the name of the common good, that is, to leave his property economically idle, he has suffered a taking."[33/] The courts also have found that when a government occupation prevents an owner from selling the occupied property for value, that use also constitutes a *per se* taking for which the injured party is entitled just compensation.[34/] If the Commission adopts NTIA's proposal, MariTEL would be precluded from using the spectrum in which it invested $84 million for any economically beneficial use. Moreover, because the spectrum would be rendered unusable if the FCC adopts NTIA's proposal, MariTEL would be prevented from assigning its spectrum to another licensee.[35/] Thus, adoption of NTIA's proposal would constitute a *per se* taking for which compensation is due.

33/ *Lucas v. South Carolina Coastal Council*, 505 U.S. 1003, 1019 (1992); *Front Royal & Warren County Indus. v. Town of Front Royal*, 135 F.3d 275, 285 (4th Cir. 1998) ("to constitute a taking, the owner must be deprived of all economically viable uses of its property").

34/ *Satellite Broadcasting & Communications Association of America v. FCC*, 146 F. Supp.2d 803, 831-32 (E.D. Va. 2001); *Loretto v. Teleprompter Manhattan CATV Corp.*, 458 U.S. 419, 435-36 (1982).

35/ MariTEL recognizes that the courts once concluded that there is no property right in the grant of license. *FCC v. Sanders Brothers*, 309 U.S. 470, 475 (1940). However, when this precedent was established, licensees were awarded by comparative hearings. Thus, licensees were not expected to pay for the licenses they were granted – as they are today. In contrast, however, at least one court has acknowledged that a licensee has a right in the investment incurred in order to obtain a license via the Commission's auction process. *FCC v. Nextwave Personal Communications*, 537 U.S. 293, 312 (2003) (recognizing the inherent property interests associated with the auctioning of a license). Indeed, as a licensee's continue to pay more for their investment in the spectrum, it would be nonsensical for the FCC to conclude that they the licensee does not have a property interest in the investment used to obtain the spectrum in the first place.

Courts have also concluded that a taking can occur when a regulation(s) denies a property owner all economically beneficial or productive use of the property.[36/] In evaluating a regulatory takings claim, courts examine the economic impact of the regulation; the extent to which the regulation has interfered with distinct, investment-backed expectations; and the character of the government action.[37/] Under this test, if the Commission adopts NTIA's proposals, it would result in a regulatory taking. As outlined above, adopting NTIA's proposal would preclude MariTEL's ability to make beneficial use of the spectrum or to recover its costs. Finally, the character of the FCC's actions adopting NTIA's proposal suggests a taking because the proposal results in a permanent invasion of MariTEL's licensed spectrum for governmental use. If the FCC, therefore, decides to adopt NTIA's proposal, it must be prepared to compensate MariTEL either by economically compensating MariTEL for the substantial investment it made in the spectrum it obtained in Auction 20 or by reallocating spectrum for MariTEL's operations.

The NTIA proposal constitutes a taking of not only channels 87B and 88B, but much of MariTEL's usable spectrum as well. Independent third party test results show that transmissions on channels 87B and 88B using the ITU-R 1371-1 protocol, operated in simplex mode, is a highly disruptive technology to other maritime VHF spectrum users. First, test results produce noticeable interference from FCC type approved ITU-R 1371-1 transponders to maritime communication over 200 kHz away from the AIS simplex transmission.[38/] Channels closer to the AIS transmitter experience increasing levels of interference. Most members of the AIS technical community agree with test results that show AIS technology spreads unwanted energy into

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36/ *Satellite Broadcasting*, 146 F. Supp.2d at 832; *Agins v. City of Tiburon*, 447 U.S. 255, 260-61 (1980).

37/ *Satellite Broadcasting*, 146 F. Supp.2d at 832.

38/ InCode's "Interference Considerations of Simplex Operation 1371 AIS Technologies with Respect to MariTEL's Spectrum." Attached hereto as **Exhibit A.**

adjacent channels. Any measurable interference from operations using ITU-R 1371-1 protocol to MariTEL's licensed spectrum is unacceptable because it prevents meaningful commercial use of the spectrum for which MariTEL paid to obtain.

Test results also demonstrate the susceptibility of ITU-R 1371-1 AIS receivers – in simplex mode – to maritime transmission on adjacent and adjoining channels.[39/] Specifically, FCC type accepted AIS equipment has shown an alarming tendency to malfunction in the presence of high power VPC transmissions on adjacent and adjoining channels.[40/] These results have been collaborated by AIS equipment manufactures and attributed to the current IEC 61993-2 test specifications.[41/]

MariTEL has shared these results with the USCG, which has ignored the findings. While publicly stating its "doubts" regarding the scope of interference, the USCG has not presented any evidence contradicting these results. Seeking a wider review of the results, MariTEL presented a portion of the results to the IALA technical and full IALA AIS Committees who "recognized the

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39/ Adjacent channel results shared with IALA Technical and IALA AIS committees. *See* attached input papers.

40/ A significant basis for the interference problems noted is the FCC's adoption, at least on an interim basis, of procedures that permit the approval of equipment that, while conforming to ITU-R standards, does not conform to Part 80 requirements. MariTEL noted the reasons why the use of this equipment, that does not otherwise conform to the FCC's rules, will cause destructive interference, in supplemental comments, submitted August 29, 2003 in the FCC's Docket No. 92-257 proceeding. As MariTEL noted in those supplemental comments, there is no precedent or current contemplation for the simplex ship station use of "B" channels (shore station) within Part 80 regulations. Based on the disruptive nature of the current AIS technology when operating in simplex mode, MariTEL requested that the FCC allow only duplex or optionally simplex on the "A" side of the channel as contemplated by current Part 80 regulations.

41/ AIS equipment manufactures note that IEC 61993-2 test specification only requires the AIS receiver to have 70dB of adjacent and adjoining channel rejection which can lead to a receiver becoming de-sensitized in the presence of high adjacent or adjoining channel power.

interference issues of the MariTEL presentation in principle"[42/] and stated the intention to incorporate MariTEL's findings into future IALA guidelines,[43/] respectively. MariTEL intends to continue to support IALA's efforts to fully quantify the results of this potentially disruptive technology. Accordingly, if the FCC grants the NTIA Petition, the taking of MariTEL's spectrum will be of a significant magnitude – and in any case, not limited at all to the channels 87B and 88B NTIA seeks to dedicate for AIS operations.

While MariTEL anticipated that it would be required to dedicate spectrum for USCG use, the extent to which NTIA now proposes to use VPC spectrum is unprecedented. As noted above, the USCG initially anticipated that VPC spectrum would be used exclusively in support of the PAWSS program to upgrade federal vessel traffic services areas. In these areas, the USCG could use the AIS system for vessel tracking and surveillance. However, as a result of the events of September 11, 2001, the USCG's mission has expanded and it now desires to use VPC spectrum beyond PAWSS areas for a stand-alone vessel tracking and surveillance application nationwide. This new requirement is clearly outside all previous regulations and agreements.

C. The NTIA Petition Raises More Questions than it Answers

The NTIA Petition suggests that channels 87B and 88B be allocated for AIS use by both Federal government and non-Federal government users on a shared basis nationwide. The NTIA Petition leaves open so many questions that must be answered before the FCC could implement such a proposal that the NTIA Petition cannot be considered a realistic request today. The NTIA Petition does not adequately address whether and where MariTEL can continue to employ

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42/ Report of Technical Working Group (WG 2) of the AIS committee, Trondheim meetings. Anecdotal information from countries who have implemented AIS report that 1) mariners often turn off their AIS transponders at night to improve TV reception; and 2) VHF maritime users have been told by the competent authority to "protect themselves" from any AIS interference.

43/ IALA AIS Guidelines, Vol. I, part 2, future revision, and Ed. 1.2 of IALA Rec. A-124. Report of the 13th Session of the IALA AIS Committee Sept. 1-5, 2003 Section 8.2

channels 87B and 88B. In that respect, MariTEL expects that NTIA did not mean to suggest that those channels could be shared between USCG and MariTEL. MariTEL assumes that when the NTIA states that the channels will be shared between government and non-government users, that sharing is designed to permit mariners – non-government entities – to use the channels.[44/]

Even, as MariTEL assumes, NTIA's reference to "sharing" is designed to permit mariners to use channels 87B and 88B for AIS operations, the NTIA Petition does not address the use of channels 87B and 88B in areas where AIS will not be employed. Channels 87B and 88B, if used for AIS purposes, will be employed along the coast and navigable waterways only. Yet, at least channel 87B may be employed throughout the United States, in both inland and coastal areas. MariTEL is the licensee of channel 87B and expects to be able to employ that frequency on an exclusive basis even if it is allocated for AIS purposes in coastal areas. NTIA does not address this issue or propose locations where channels 87B and 88B must be reserved for AIS, and locations where it may be employed, inland, for non-AIS purposes.[45/]

The NTIA Petition also does not address the types of entities that could use channels 87B and 88B for AIS purposes. MariTEL expects that NTIA anticipates that mariners could employ channels 87B and 88B for shipborne AIS transmissions. MariTEL also expects that NTIA anticipates that that the USCG would use channels 87B and 88B in order to communicate with

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44/ If MariTEL's assumption is correct, it is not clear under what authority mariners can use channel 88B today. The USCG has asserted that channel 88B is allocated on an exclusive basis for government use. If the USCG is correct, then the use of channel 88B by mariners is not in accordance with the U.S. Table of Frequency Allocations. If the NTIA believes that the FCC's Public Notice of June 13, 2002 permits mariners to employ channels 87B and 88B for shipborne AIS operations, that Public Notice constitutes an impermissible avoidance of notice of comment rule making in violation of the Administrative Procedures Act by amending the Table of Frequency Allocations to re-allocate channel 88B for non-government operations.

45/ As MariTEL notes below, it proposes to act as the frequency coordinator for the use of channels 87B and 88B. If the FCC adopts MariTEL's proposal, it will address these issues to ensure that use of AIS technology in coastal areas by either mariners or the USCG is not subject to interference from other uses of channels 87B and 88B.

mariners. However, NTIA does not indicate whether it expects that other non-federal government entities could use channels 87B and 88B for shore station operations. For example, should MariTEL be permitted to employ channels 87B and 88B in an AIS system in support of commercial navigational purposes (presumably outside of areas where the channels are being used by Federal government entities)? Should any other entities, besides MariTEL and Federal government entities, be permitted to use AIS channels for shore station operations? It is unacceptable that the NTIA Petition would further intrude on MariTEL's licensed frequencies by permitting non-Federal government or commercial entities to do so without engaging in a market based transaction with MariTEL.[46/] Approval of this Petition arbitrarily discriminates against MariTEL by allow non-federal government entities to profit from the use of VPC spectrum while eliminating MariTEL's participation in the AIS industry.

D. Alternative Solutions to the NTIA Petition

1. The FCC Should Direct NTIA and USCG to re-enter Negotiations with MariTEL

As discussed above, the FCC should direct the NTIA and USCG to re-enter negotiations with MariTEL under the authority established in Section 80.371 of the rules. The outcome of those negotiations could range from an alternate frequency configuration to providing replacement spectrum.

46/ While it is clear that no entity – government or non-government – can transmit on channels 87B and 88B (or any other frequency) without authorization, it is not clear whether entities can monitor those channels and use the information monitored on a commercial basis. MariTEL believes that as the licensee of channels 87B and 88B, it is permitted to monitor AIS traffic and provide access to information it obtains from monitoring – vessel location information, for example – for a fee. MariTEL believes it would be a diminution of its rights as the FCC licensee of channels 87B and 88B if others were permitted to engage in the same activity. The FCC should use this proceeding to clarify the extent to which channels 87B and 88B may be monitored, by whom, and for what purposes.

Providing replacement spectrum dedicated for government use when there is a critical government need for spectrum licensed to non-government entities is consistent with past practices. For example, in 1997, the Commission reallocated the digital electronic message service ("DEMS") from the 18 GHz band to the 24 GHz band in response to NTIA's request that this spectrum be allocated for Governmental use.[47/] The DEMS spectrum was initially licensed in 1983 for the purpose of providing high-speed, two-way point-to-multipoint terrestrial microwave transmission systems.[48/] In 1997, NTIA asked that the FCC take action to protect military satellite systems in the 18 GHz band and proposed to make 400 MHz of spectrum (400% of the spectrum originally authorized for DEMS) available in the 24 GHz band to allow the Commission to relocate DEMS licensees.[49/] The Commission amended its rules to adopt the changes requested by NTIA without notice and comment.[50/]

Although no formal rulemaking occurred, intra-agency negotiations occurred which resulted in a consensual solution. Specifically, NTIA communicated to the FCC that it was willing to provide alternative spectrum for the reallocation of DEMS licensees from the 18 GHz band to the 24 GHz band. The primary reason that the Commission acquiesced to NTIA's

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47/ *Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service from the 18 GHz Band to the 24 GHz Band and to Allocate the 24 GHz Band for Fixed Service,* ET Docket No. 97-99, *Order*, 12 FCC Rcd 4990 (1997) ("DEMS Order").

48/ *Amendment of the Commission's Rules to Relocate the Digital Electronic Message Service from the 18 GHz Band to the 24 GHz Band and to Allocate the 24 GHz Band for Fixed Service*, ET Docket No. 97-99, *Memorandum Opinion and Order*, 13 FCC Rcd 15147 ¶ 5 (1998) ("DEMs Order on Petitions for Reconsideration").

49/ *DEMS Order on Reconsideration* ¶ 10 ("Taking into account our common interests . . . [NTIA] could make available spectrum in the region of 24.25-24.65 GHz [and] the Commission [could] take such steps as may be necessary to license the DEMs stations in this spectrum.")

50/ Under the APA, notice and comment is not necessary in military affairs situations. 5 U.S.C. § 553(a).

request was because NTIA offered alternative spectrum to accommodate the DEMS licensees.[51/] In fact, the Commission clarified that because NTIA made the spectrum available to accommodate DEMS reallocation and not for any other purpose, it was not required to consider the reallocation by way of a rulemaking because a rulemaking would not have enlarged the possible uses of the spectrum.[52/] The only licensee affected by this transaction – Telidesic – did not object to the reallocation because the FCC's action ensured that it could operate its satellite system on the spectrum without the interference that would have resulted from the DEMS licensees.[53/]

The FCC's *DEMS Order* is instructive in illuminating the deficiencies in the NTIA Petition. First, NTIA, through several letters to the FCC identified replacement spectrum along with its proposal to relocate non-government entities.[54/] In this instance, NTIA simply seeks the use of channels 87B and 88B without making any attempt to either assess the spectrum impact of its proposal on MariTEL or to identify replacement spectrum. Therefore, the FCC should reject the NTIA Petition until such time as NTIA more thoroughly assesses the impact of the proposal on MariTEL and identifies the spectrum that it proposes that MariTEL be permitted to employ, in lieu of the spectrum being reallocated from MariTEL.

Second, as the *DEMS Order* also makes clear, the reallocation of licensees in the 18 GHz and 24 GHz bands in that case was accomplished on a consensual basis.[55/] In this instance, any proposed reallocation of MariTEL from channels 87B and 88B would not be consensual. Not

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51/ *DEMs Order* ¶¶ 5-6; *DEMs Order on Reconsideration* ¶ 26.

52/ *DEMs Order on Reconsideration* ¶ 26.

53/ *DEMS Order on Reconsideration* ¶¶ 16-18.

54/ *DEMS Order* ¶¶ 5-6.

55/ *DEMS Order* at n.20.

only has NTIA not proposed replacement spectrum to MariTEL, but it has not even contacted MariTEL with a proposal regarding replacement spectrum. Therefore, while the *DEMS Order* represents an instance where NTIA acted responsibly to accommodate a government spectrum need, it has not acted in the same fashion in this proceeding. Therefore, the FCC should deny the NTIA Petition until such time as NTIA identifies replacement spectrum, and negotiates with MariTEL in good faith regarding the identity of that replacement spectrum (or at least provides notice of such replacement spectrum to MariTEL in advance of proposing its reallocation to the FCC).[56/]

2. AIS Spectrum Coordination

One of the most significant impacts of the plan contained in the NTIA Petition is the havoc it would wreak on MariTEL's ability to participate in the AIS industry. While, as MariTEL stated in reply comments to its Extension Request, it does not wish to interfere with the use of AIS technologies by the USCG – in support of the USCG's collision avoidance or homeland security missions – there are other ways in which MariTEL can provide service to mariners, the USCG and the FCC by participating in the AIS industry. When MariTEL secured the use of channels 87B and 88B, it was aware that those channels would be employed in support of AIS operations. It expected that it would be able to operate AIS systems (not for collision avoidance, but for commercial vessel tracking purposes) in areas where the USCG was not. If

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56/ MariTEL notes that in the *DEMS Order* the FCC did not engage in notice and comment rule making because of the national security interests involved. Nevertheless, the *DEMS Order* provided affected parties with a thirty-day period to protest the proposed allocation. As noted above, none of the directly affected parties protested the FCC's action because the reallocation in which the FCC engaged was consensual. Because NTIA has not sought MariTEL's involvement in this process, it is unlikely that any reallocation of MariTEL's spectrum holding could be consensual today.

the FCC grants the NTIA Petition, it will limit MariTEL's ability to participate in the AIS industry.

MariTEL can continue to participate in the AIS industry by being designated as the recognized frequency coordinator for channels 87B and 88B. MariTEL has provided the FCC with a proposal regarding its proposal to act as a coordinator for use of channels 87B and 88B and the FCC seeks comment on that proposal.[57/] MariTEL does not wish to burden the record of this proceeding by reiterating the MariTEL AIS Proposal here. To the extent questions are raised regarding the MariTEL AIS Proposal, MariTEL will address those questions in reply comments responsive to the DA03-3669 proceeding. However, MariTEL asks that the FCC combine the records in these two proceedings so that the MariTEL AIS Proposal can be considered in response to the NTIA's contention that channels 87B and 88B are required for USCG use. As noted above, the NTIA Petition highlights the USCG perceived need but does not address how satisfaction of the USCG's requirements can be met without harm to MariTEL. On the other hand, MariTEL has proposed a reasonable solution to this issue.

III. CONCLUSION

For the foregoing reasons, MariTEL urges the Commission to reject NTIA's Petition and instead direct the USCG to negotiate with MariTEL, as the Commission's rules provide, for the use of up to two narrowband offset pairs or an alternate solution amenable to both parties. Granting NTIA the relief it seeks requires the FCC to strip MariTEL of the rights it obtained as the high bidder of VPC licenses in Auction 20. In addition, affording NTIA with the relief it

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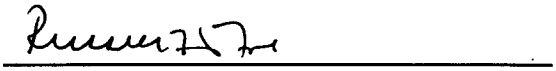
57/ *Wireless Telecommunications Bureau Seeks Comment on MariTEL, Inc. Proposal to Serve as Automatic Identification System (AIS) Frequency Coordinator*, DA 03-3669, November 19, 2003, citing Letter dated November 7, 2003 from Dan Smith, President and CEO, MariTEL, to Catherine W. Seidel, Deputy Chief, Wireless Telecommunications Bureau ("MariTEL AIS Proposal").

requests would result in an unconstitutional taking for which MariTEL must be afforded just compensation. If the Commission does adopt NTIA's proposal and dedicates channels 87B and 88B for AIS use on an exclusive basis, it must therefore compensate MariTEL for the amount of its investment in its VPC licenses, or designate MariTEL as the AIS frequency coordinator for the VPC band.

Respectfully submitted,

MariTEL, Inc.

By: 

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December 1, 2003

EXHIBIT A

Interference Considerations of Simplex Operation

1371 AIS Technologies With Respect To

MariTEL's Spectrum

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October, 2003

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Interference Considerations Of Simplex Operation 1371 AIS Technologies With Respect To MariTEL's Spectrum

Prepared for: MariTEL, Inc.

Presented on: October 9, 2003

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3.1 Worst Case Example Receiver Desensitization Example Calculation 19

Objective:

This report will encapsulate the results of tests performed from August 28th through September 12th by inCode Telecom Group, Inc. (inCode) on behalf of MariTEL, Inc (MariTEL) to investigate the potential interference between ITU1371 AIS technologies and MariTEL's VHF Public Coast spectrum (further referred to in this report as VPC).

InCode took a two-prong approach to this investigation by evaluating the theoretical makeup and derivation of the interference and by establishing an in-lab study to validate the two distinct types of interference. The first type of interference focused on the occurrence of a MariTEL VPC shore station infrastructure (VPC BS) into an ITU 1371 AIS shore station (AIS BS) operating in "high seas" simplex mode using international Channels 87B and 88B. The second type of interference investigated focused on an ITU 1371 AIS ship station (AIS MS) operating in the near proximity to a MariTEL ship station (VPC MS) using MariTEL's VPC neighboring channels.

Summary:

The goal of this section is to provide a high level summary of the test results detailed in this document. The VPC BS to AIS BS interference will be discussed first. InCode examined the interference from a theoretical and measured perspective. InCode's Shared Site Interference (SSI) Analysis software examined the transmitter noise induced from a VPC BS into an AIS BS. The levels showed a significant amount of transmitter noise injected into the AIS BS receiver. The details of the SSI study can be found in the Appendix. The key point of the SSI analysis indicated that a –121 dB transmitter noise margin that reached the AIS BS receiver antenna and its level of susceptibility at the antenna spaced 25 kHz away from the AIS simplex channel. The out of band energy in the AIS BS receiver path from the offending VPC BS transmitter can only be reduced through additional attenuation of the signal between the offending VPC transmitter and the AIS receiver. This would mean using free space loss and / or geographic separation to achieve necessary attenuation.

InCode validated the theoretical interference by establishing an AIS mobile to base network in a lab and simulating the interfering VPC signal using IEC 61993-2 testing criteria through a signal generator into a closed system using a combiner and properly attenuated signals. It can be noted that the IEC 61993-2 test provided a 3 kHz modulated offending signal that is very similar in waveform to the MariTEL SEA 157M VHF analog FM radio at normal excitation. Upon completion of the testing it was noted that an offending VPC signal as weak as –43dBm could effect the AIS base unit under test. It was also noted that due to the significant transmitter energy in the AIS receiver band, the AIS BS would have a network communication failure with a VPC offending signal level of –25dBm at 100 kHz off center-frequency of the AIS receive channel. Diagram 3 highlights these variances in the Results Section of this report to show the outcome of the tests performed.

To summarize, the AIS BS was susceptible to VPC BS interference due to the Simplex AIS operations use of Channels 87B and 88B in the VPC shore side channel band. This interference occurs because VPC duplex operation transmits on the shore side of the VPC spectrum band

designated as the B band. This B band is inclusive of the internationally designated AIS Channels 87B and 88B. The simplex nature of AIS necessitated the technology to both transmit and receive in the B Band. Normally this transmitter energy, or noise, is dealt with by large frequency separations. In the case of the Marine VHF Public Coast Station Band, the FCC designed this separation to be 4.6MHz with duplex operations. Due to the election of simplex operations by the AIS technology there is not enough spectrum available, only 175kHz, for separation. InCode was able to demonstrate this through theoretical derivation and the lab testing as part of this report.

Due to the random nature and self aligning characteristics of the AIS 1371 technology it was difficult to determine the exact offending signal level required to interfere with the AIS BS unit to cause a consistent industry standard 80% Packet Success Rate (PSR). However, when the offending VPC signal was increased to drive the AIS BS into communication failure, there is consistency within these limits. In any case, certain generalities can be determined from the outcome of the lab tests, which are backed by theoretical analysis. VPC offending signals that drive an AIS BS beyond reception of 80% PSR will quickly deteriorate its reception of AIS data within a few additional dB of VPC offending signal to the AIS communication failure point. AIS's frequency diversity by using channels 87B and 88B only provides a limited improvement (3 dB) if the offending VPC signal is below channel 87B. If Channel 28B were used for the offending channel then it would be only 25 kHz on either side of the AIS channels and would eliminate any improvement from frequency diversity.

The second type of interference investigated is the AIS MS operating in simplex mode on Channels 87B and 88B in near proximity to a VPC MS using MariTEL's VPC neighboring channels. InCode established a closed RF link network between two SEA 157M VHF radios using the same combiner, attenuators and coax as defined by the previous interference test. An AIS MS was programmed on neighboring channels to simulate the AIS MS interference into a VPC MS. This report details the noise components recorded with a voice recording received at the VPC MS. The Results Section shows the different types of interference. The interference is a 26msec noise spike occurring from the AIS impulse noise in concert with the transmitter noise. The transmitter noise is the same phenomenon as indicated in the first interference case. The difference is that the transmitter noise has an additional component to include a Guassian noise caused by the energy required to complete a 1msec ramp time of the AIS time slot. This impulse noise intensifies the interference by causing it to spread at low levels to several MHz away from the AIS simplex channels. For the purpose of this testing, inCode measure across 25 to 225 kHz to see the effects. What was observed is that there is a direct correlation between the signal threshold received at the VPC MS radio and the offending signal level required to cause interference. This correlation appears to follow a C/I ratio but that was not verified for purposed of this testing. Due to the nature of the Simplex operation of the AIS, guard bands around these channels and / or an improvement in the transmitter emission mask of the AIS device could substantially reduce the impact of the transmitter noise and diminish the effect of the spreading caused by the impulse noise.

A matrix was developed showing selected signal levels for both the VPC MS received signal level and the VPC MS received signal level from the offending AIS MS and resulting interference. From reviewing Diagram 8 located in the Results Section, it can be noted that 25

and 50 kHz away from the AIS channels, significant interference occurs even at a relatively strong received path to the VPC MS from its BS. At 75 and 100 kHz, significant interference levels result when the VPC RF link moves towards its outer coverage limit thus reducing the coverage radius of the VPC system during the AIS interference transmission. A VPC receive channel greater than 100 kHz from the AIS center frequency received an influence from the impulse noise and thus provided a low level interference with a –30dBm offending signal level from the AIS MS into the VPC MS receiver. A 0dBm offending signal level also provides a strong interferer when the VPC RF link fell below –99dBm at the VPC MS receiver. Both AIS and VPC systems are designed to have large coverage areas upwards of 40 miles and this interference substantially reduces the operational range of a VPC network.

Based on this interference it can be generalized that VPC MS will have significant impact to its operation every time the AIS MS transmits a message on a time slot. Because this interference is transmitter noise coupled with impulse noise it will require a significant amount of attenuation to greatly reduce the effects of this interference. Although inCode only tested a FM modulated VHF radio using Harvard phonetically balanced voice phrases, it is noted that a digital radio technology would experience significant interference whenever the AIS MS unit was transmitting. In a digital radio environment it would be expected that data packets would not be successfully decoded on the VPC MS receiver end and would impact the data rate at that instance in time. Depending on the occurrence rate, the VPC data transfer can be completely destroyed and some VPC technologies may have difficulty realigning and overcoming this continual interference. The interference impact was found to occur across the entire MariTEL spectrum band in varying degrees based on the VPC MS received RF link from the VPC BS and the intensity of the AIS offending transmission level as received by the VPC MS.

Test Setup:

The set up for the lab investigations included two different configurations. Each configuration is depicted and includes the measured losses through the system. The first configuration found in Diagram 1 (VPC BS interference into AIS BS) was established to validate the interference incurred by the AIS BS from the VPC BS. The second configuration found in Diagram 2 (AIS MS interference into VPC MS) validated the interference incurred by the VPC MS from the AIS MS.

Both configurations used a leading manufacturer AIS hardware platform. The AIS BS software was loaded onto one of the mobile hardware units to provide the full AIS network functionality for a lab environment and was verified for proper operation by the manufacturer's personnel. The AIS units under test had been FCC and USCG approved for operation in the United States and abroad. For purposes of VPC technology selection under test, inCode used MariTEL's SEA 157M analog FM VHF radios. One of the SEA 157 radio's microphone circuit was tapped to inject Harvard phonetically balanced phrases and to record the interference from the AIS MS transmitter noise for the AIS MS to VPC MS.

VPC interference simulation was performed to the specifications in the IEC 61993-2 test document. The only exception to the IEC 61993-2 was in the requirement for the AIS unit to be set to –104dBm (3 dB below the ITU established receiver sensitivity of –107dBm) and attain an 80% PSR. The AIS test units supplied would not meet this requirement and a –99dBm receiver

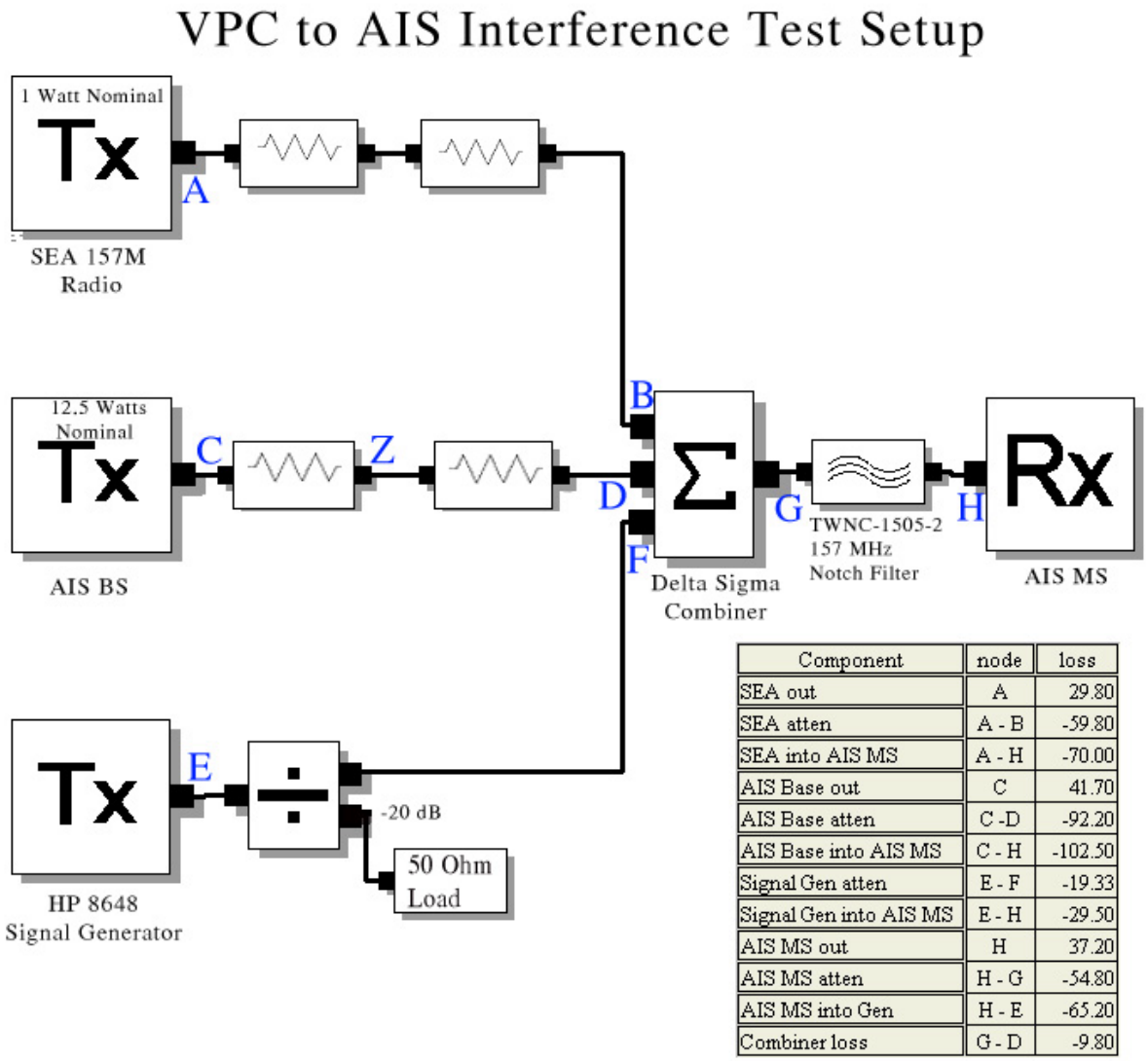
threshold attaining an 80% PSR was established for the basis of all testing. InCode used an HP 8648 signal generator to simulate VPC interference. An HP 8560 spectrum analyzer was used to monitor power levels and also view waveforms. A 20dB bi-directional RF coupler was used inline with the spectrum analyzer to keep unwanted energy from overloading its front end. An HP E4416A power meter and HP 9321 probe was also used to have calibrated power levels for the AIS, SEA radios and to verify the signal generator calibrated signal levels.

The VPC BS interference into AIS BS configuration shown in Diagram 1 was the basis for the testing performed to validate the VPC BS TO AIS BS interference. This configuration employed a closed loop network to simulate an open environment, but allowed inCode to control the path losses between the different devices. A Delta Sigma 8 channel hybrid combiner was used to provide the means to combine the AIS MS to AIS BS link and to allow the offending simulated VPC BS interferer to reach the AIS BS. All power levels were verified with both the spectrum analyzer and the power meter. Load bank attenuators were measured through a known calibrated signal to determine their loss values and the received signal power level was calculated by summing the loads, transmitter power levels and the cable losses.

The AIS units were programmed to full duplex mode operation and a 157 MHz notch filter was placed inline between the combiner and the AIS MS. Full Duplex operation was used instead of Simplex to allow inCode the ability to isolate the return path of the AIS MS from transmitting unwanted energy back into the test equipment and desensitizing it. The AIS BS was programmed to transmit on 161.975 MHz on a 25 kHz basis. The VPC BS interferer was simulated using an HP 8648 signal generator set to transmit on 161.95 MHz center frequency with 3 kHz FM modulation as described in the IEC-61993-2 test documentation. The AIS BS transmitted an AIS message at an established interval to the AIS MS. The AIS MS's software verified the proper receipt of the packets transmitted. Several hundred packets were sent per test and the PSR was calculated by taking the difference of the packets received at the AIS MS from the packets sent from the AIS BS over the total packets sent. The AIS link was verified between every test to make sure the AIS units were in proper working order and attained at least 80% PSR without any outside influence on them. This assured that when a the AIS units had a communication under a certain interfering level that they would still operating properly for the next test.

Several different scenarios were run and the results of these tests can be seen in the Results Section under Diagram 3. Primarily the AIS units were set to only transmit on one frequency instead of alternating between 87B and 88B. The purpose for this was to better validate the interference at specified channel spacing under certain conditions. These test conditions included varying the received AIS mobile power from –99dBm to –75dBm to show different performance with weaker or stronger AIS RF link. Also measurements that included both 80% PSR and complete AIS network transmission failure due to VPC interference were run. As stated in the Summary section, the random nature of the AIS technology as it relates to the PSR calculation made it difficult to achieve consistent received signal strength correlations with every test ran. The complete AIS transmission failure point measurement was consistent however. A test run was also performed to include AIS operation on Channels 87B and 88B to validate the ability of the technologies frequency diversity to improve the single AIS frequency test. During

this run the VPC interfering frequency was not placed between the two channels on channel 28B but instead deployed on channels 27B and below to provide the adequate channel spacing.



Component	node	loss
SEA out	A	29.80
SEA atten	A - B	-59.80
SEA into AIS MS	A - H	-70.00
AIS Base out	C	41.70
AIS Base atten	C -D	-92.20
AIS Base into AIS MS	C - H	-102.50
Signal Gen atten	E - F	-19.33
Signal Gen into AIS MS	E - H	-29.50
AIS MS out	H	37.20
AIS MS atten	H - G	-54.80
AIS MS into Gen	H - E	-65.20
Combiner loss	G - D	-9.80

Diagram 1: VPC BS interference into AIS BS

Diagram 2 shows the configuration of the AIS MS to VPC MS interference test setup. All of the same hardware and test equipment were used for this configuration as with that described above. The main difference in the configuration was a SEA 157 radio replaced the AIS MS behind the combiner and the notch filter was not needed for this exercise. The configuration also shows the AIS MS was moved forward of the combiner. For purposes of the test, the AIS BS was used to simulate the AIS MS due to the security restrictions limiting inCode's ability to program the unit and force it to send AIS messages at predetermined intervals for which the AIS BS software has

the ability to do. This change does not effect the AIS simulated operation since both units can operate in either a BS or MS mode and makes no difference from an RF perspective.

For this test the goal was to send pre programmed messages across the VPC link to simulate conversations and to audibly measure the interference produced by the AIS MS into the VPC MS. The other SEA 157 radios audio circuit was tapped to record the interference produced. Diagrams 4-7 in the Results Sections show a typical recorded output from the SEA 157 radio.

The SEA 157 radios were actually operated in Simplex mode using channel 27A or 157.35 MHz. The first SEA was continually keyed and the Harvard phrases were played across the microphone circuit. The second SEA 157 radio received the messages on the same frequency and the resultant audio output was recorded. The AIS MS was programmed to transmit intermittent AIS messages at approximately 10-second intervals to simulate the live AIS marine environment. The AIS MS center frequency was set to Channel 87A or 157.375 MHz. This setup would simulate the exact RF effect of having an AIS MS operating on channel 87B interfering with an full duplex operation VPC MS receiving a transmission from its VPC BS network on Channel 27B.

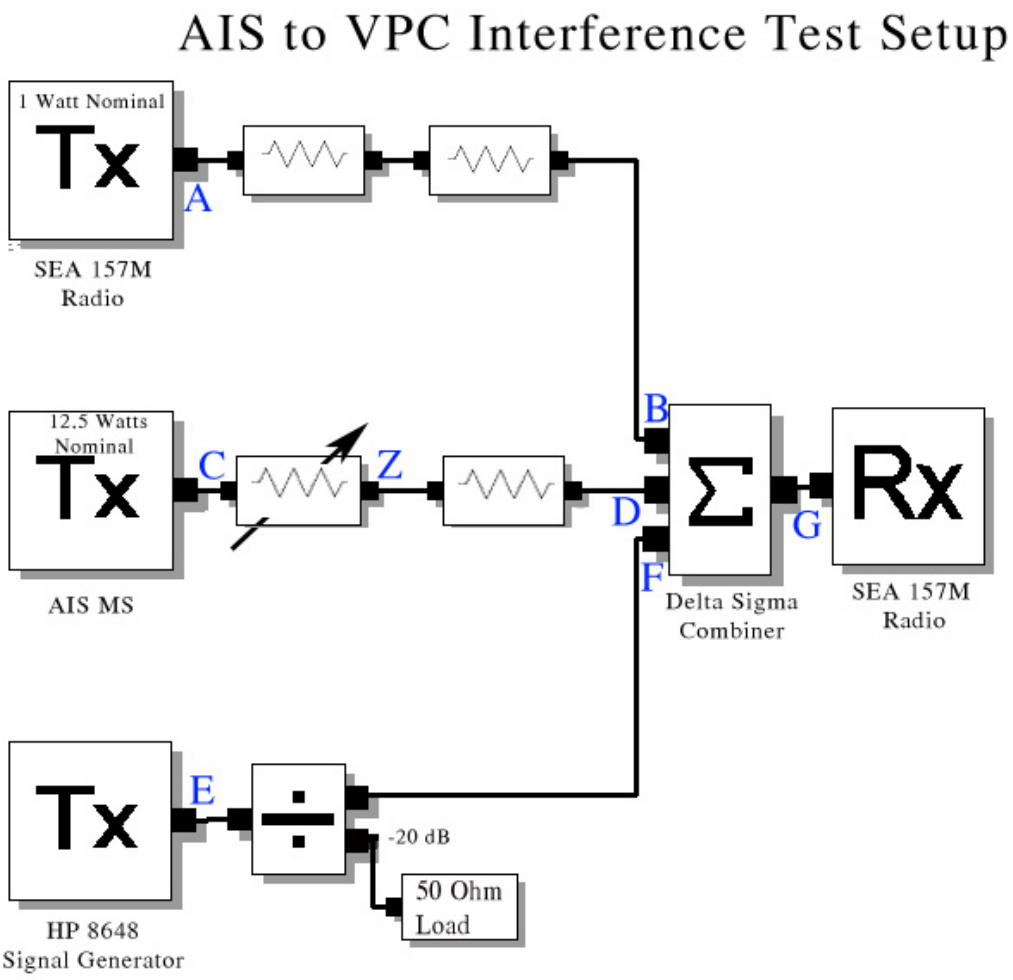


Diagram 2: AIS MS interference into VPC MS

Results Section:

This section provides an overview of the outputs measured during the testing performed.

BS VPC interference into AIS BS summary of data

For the VPC BS to AIS BS interference, a graph depicted in Diagram 3 below shows the relationship between the AIS BS received signal level from the AIS MS and its ability to receive AIS messages successfully at the 80% PSR or to full AIS transmission communication failure. The graph shows three scenarios where the AIS MS was received at the AIS BS with –75, -93 and –99dBm signal level where the AIS messages failed due to VPC interference. These three scenarios only used one AIS frequency to show the effect of varying the VPC interferer to specified channel spacing off of the AIS center frequency. The fourth and fifth scenarios show a

stronger received signal level of –75dBm at the AIS BS from its MS and the 80% PSR with an injected VPC signal level. The level of the offending VPC signal as received by the AIS BS is shown on the vertical axis (left hand column). The only difference between the two scenarios is that the fourth scenario used only channel 87B for its transmissions and the fifth scenario varied between channels 87B and 88B.

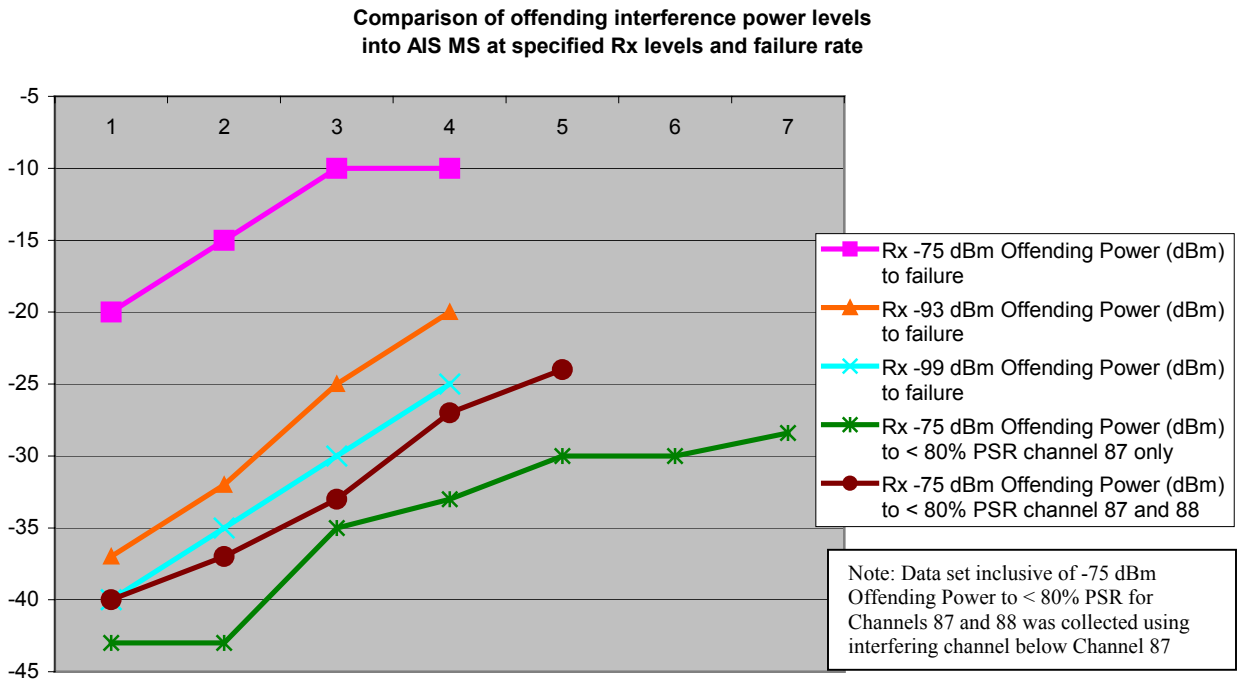


Diagram 3: VPC BS offending levels VS channel spacing @ AIS PSR / failure limits

AIS MS interference into VPC MS radio

For the AIS MS to VPC MS interference, Diagrams 4-7 depicts the measured results of the interference as recorded at the audio circuit of the SEA 157 radio. The difference between Diagrams 4, 5 and 6 are the intensity of the AIS interference recorded. Diagram 4 shows a "high" level of interference. This can be seen by the solid bar appearing in the highlighted red oval on the right hand side of the audio waveform clip. The audio clip shows intensity on the vertical axis and time domain on the horizontal axis. It is very intense and its average level exceeds all of the peaks in the voice waveforms as seen to its left. These voice waveforms correspond to the Harvard phrases sent from the originating SEA 157 radio. The difference between Diagrams 5 and 6 is they have a reduced intensity to show a "medium" and "low" level of AIS interference. The AIS interference for these two diagrams is also highlighted in a red oval. The AIS interference can be seen as a shorter bar with some variance in intensity but below the level of the voice conversation waveforms. Diagram 6 AIS interference is low compared to the voice waveforms. Diagram 7 shows a zoom in on the time intervals so you can see the 26msec AIS timeslot message transmission and its initial 1msec ramp up and ending 1msec ramp down. These waveform diagrams show the substantial energy levels recorded during the testing.

Diagram 8 indicates a summary table of all of the measure AIS MS interference into the VPC MS audio clips. The table in the diagram is organized by 25 kHz channels spaced increasingly further away from the AIS MS center frequency to include all tests performed. Each 25 kHz channel shows the relative strength of the AIS MS interference by category. Each category was broken down in four types: VL, L, M and H. These stand for "very low', "low", "medium" and "high" levels of interference. The rows correspond to the AIS MS received signal at the VPC MS in dBm. Three levels were measured during the tests. These levels were –60, -30 and 0dBm. This would correspond to a approximately a distance of the AIS MS into the VPC MS of 15 miles, 0.5 miles and 100' respectively using straight free space calculations. This distance would be the distance required to isolate the AIS MS from the VPC MS to greatly reduce the interference level to an acceptable rate. The rows of each group indicate the VPC MS received signal level from its VPC BS transmission. There were four levels measure and they are: -30, -0, -90 and –105dBm. These levels would correspond to an approximate geographic spacing requirement of: 0.9, 25, 38 and 45 miles respectively. These distances are estimates that take into account free space loss, fading and other design characteristics required to design a VPC network. These distances would be required to reduce the AIS interference to an acceptable level using only distance as an attenuating factor.

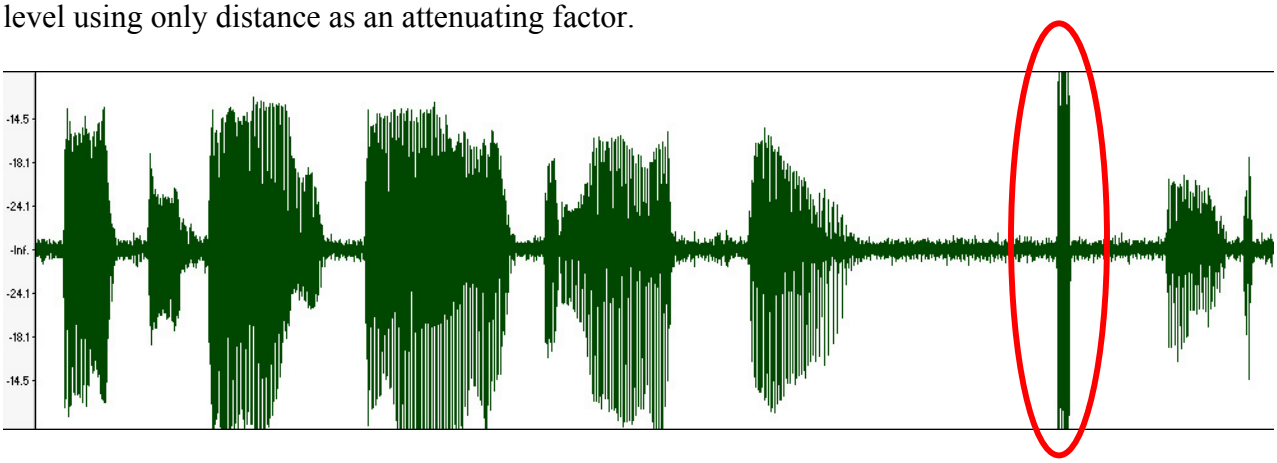


Diagram 4: AIS MS high level interference recorded from VPC MS radio

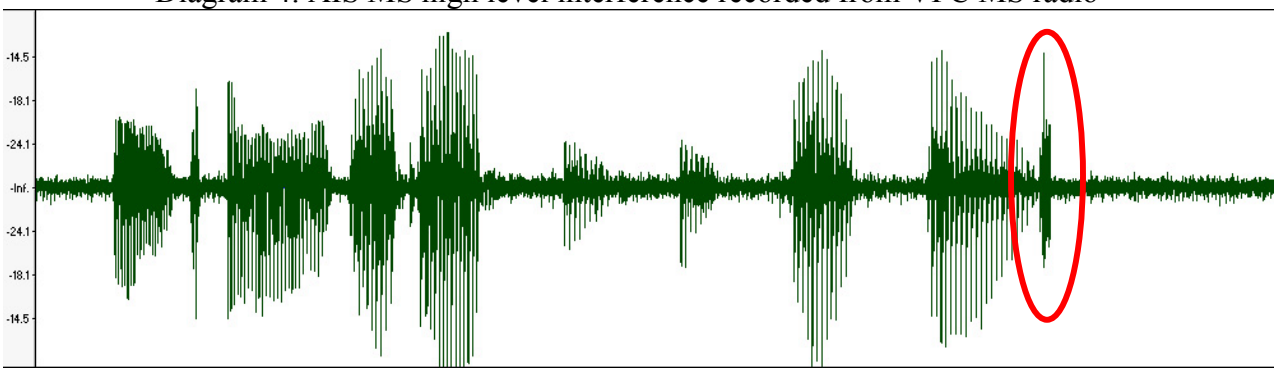


Diagram 5: AIS MS medium level interference recorded from VPC MS radio

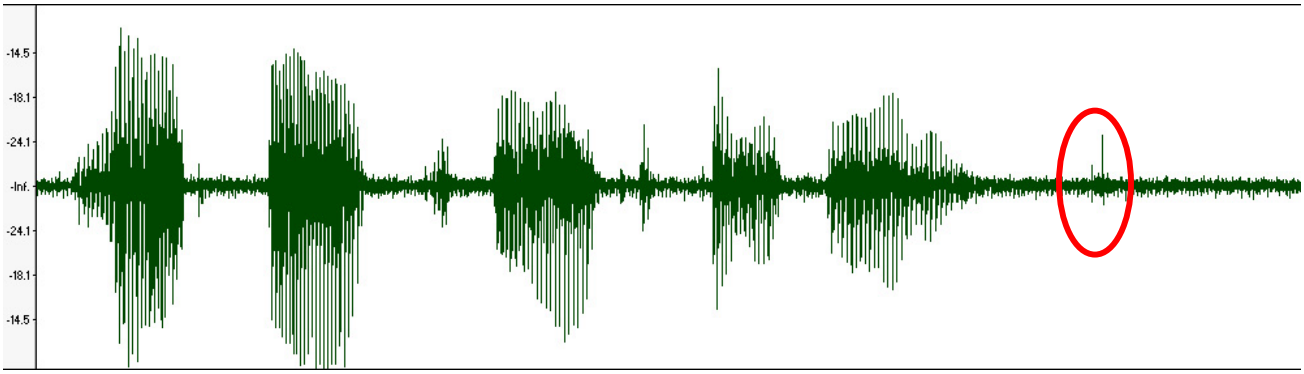


Diagram 6: AIS MS low level interference recorded from VPC MS radio

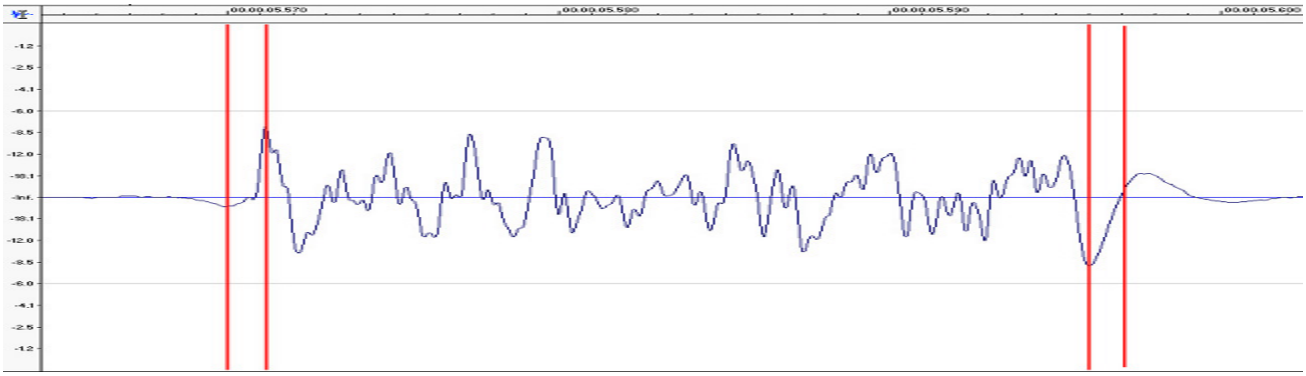


Diagram 7: Detailed view of AIS MS interference recorded from VPC MS radio

25 kHz Channel Spacing

Miles	DBm	-30	-60	-99	-105
15	-60	--	--	VL	VL
0.5	-30	--	--	M	H
100'	0	VL	H	H	H
	Miles	*0.9*	*25*	*38*	*45*

50 kHz Channel Spacing

Miles	dBm	-30	-60	-99	-105
15	-60	--	--	--	--
0.5	-30	--	--	M	H
100'	0	VL	M	H	H
	Miles	*0.9*	*25*	*38*	*45*

75 kHz Channel Spacing

Miles	DBm	-30	-60	-99	-105
15	-60	--	--	--	--
0.5	-30	--	--	L	H
100'	0	VL	L	H	H
	Miles	0.9	25	38	45

100 kHz Channel Spacing

Miles	dBm	-30	-60	-99	-105
15	-60	--	--	--	--
0.5	-30	--	--	L	H
100'	0	VL	VL	H	H
	Miles	0.9	25	38	45

125 kHz Channel Spacing

Miles	DBm	-30	-60	-99	-105
15	-60	--	--	--	--
0.5	-30	--	--	VL	L
100'	0	VL	VL	H	H
	Miles	0.9	25	38	45

225 kHz Channel Spacing

Miles	dBm	-30	-60	-99	-105
15	-60	--	--	--	--
0.5	-30	--	--	VL	L
100'	0	VL	VL	H	H
	Miles	0.9	25	38	45

AIS Interference Level

VL	Very Low
L	Low
M	Medium
H	High

Diagram 8: Summary of AIS MS in VPC MS Interference

Appendix:

1.0 Analysis Summary

The results of this analysis indicate the distinct probability of interference problems from adjacent channels to the AIS system from VPC radios operating in the vicinity of the AIS transponders. Reciprocally, the VPC radios will suffer from interference from the AIS system on the ship borne unit. The level of interference indicated suggests the need of 15 miles or less horizontal separation. Obtaining enough vertical separation may be impractical due to the severity of transmitter noise interference levels identified. The interference from adjacent channels will severely hamper the ability of the AIS system to "listen" to boats in the open seas and could very well destroy operations all together. Joint planning and implementation is recommended in order to deal with these issues.

2.0 Transmitter Noise Analysis

Transmitter noise is interference caused by noise generated by a transmitter that falls within a receiver's bandwidth. This noise level is compared with the receiver's susceptibility. Receiver susceptibility is determined by calculating the equivalent noise floor of the receiver system. This is based on the sensitivity of the receiver and the modulation scheme. For this analysis, susceptibility is considered to be 6 dB below the noise floor. The analysis predicts the transmitter power level in the receiver bandwidth at the receive frequency. The difference between the receiver susceptibility and the predicted interfering power level is called the noise margin. If the noise margin is positive, the number represents the margin before interference occurs. If the noise margin is negative, the amount represents the level of improvement in isolation required between the transmitter and receiver. The system also accumulates the effects of all transmitters on a receiver at a site. The levels in figure 1.0-1 show the predicted worst-case transmitter noise margin between receivers and transmitters at the site.

TX System	TX (MHz)	RX System	RX (MHz)	N_{TX} (dBm)	L_{TX-Ant} (dB)	$L_{Ant-Ant}$ (dB)	$N_{at\ Ant}$ (dBm)	$S_{at\ Ant}$ (dBm)	N_{Margin} (dB)
VPC 25k	161.9625	AIS 1371	161.975	47.9	2.6	22.0	23.3	-132.6	-155.9
AIS 1371	161.975	VPC 25k	161.9625	58.0	2.6	22.0	33.4	-132.6	-166.0
VPC 25k	161.95	AIS 1371	161.975	15.8	4.5	22.0	-10.7	-132.6	-121.9
AIS 1371	161.975	VPC 25k	161.95	58.0	4.5	22.0	31.5	-132.6	-164.1
VPC 25k	161.9375	AIS 1371	161.975	6.9	6.3	22.0	-21.5	-132.6	-111.1
AIS 1371	161.975	VPC 25k	161.9375	54.3	6.3	22.0	25.9	-132.6	-158.5
VPC 25k	161.925	AIS 1371	161.975	-2.1	8.2	22.0	-32.3	-132.6	-100.2
AIS 1371	161.975	VPC 25k	161.925	26.0	8.2	22.0	-4.2	-132.6	-128.4

Table 1.1 – VPC Radio on 25 kHz Channel vs. AIS 1371 Radio Transmitter Noise

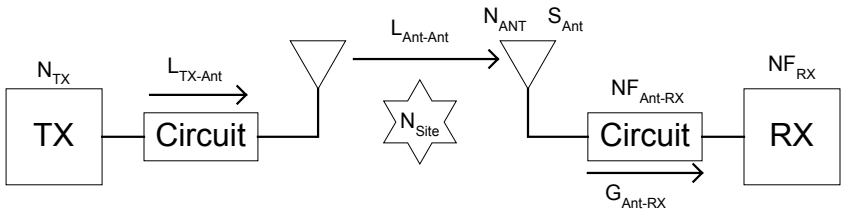
TX System	TX (MHz)	RX System	RX (MHz)	N_{TX} (dBm)	L_{TX-Ant} (dB)	$L_{Ant-Ant}$ (dB)	$N_{at\ Ant}$ (dBm)	$S_{at\ Ant}$ (dBm)	N_{Margin} (dB)
VPC 12.5k	161.9625	AIS 1371	161.975	7.0	2.6	22.0	-17.6	-132.6	-114.9
AIS 1371	161.975	VPC 12.5k	161.9625	55.5	2.6	22.0	30.9	-132.1	-163.0
VPC 12.5k	161.95	AIS 1371	161.975	-3.4	4.5	22.0	-29.8	-132.6	-102.7
AIS 1371	161.975	VPC 12.5k	161.95	55.5	4.5	22.0	29.0	-132.1	-161.1
VPC 12.5k	161.9375	AIS 1371	161.975	-13.3	6.3	22.0	-41.7	-132.6	-90.9
AIS 1371	161.975	VPC 12.5k	161.9375	51.8	6.3	22.0	23.4	-132.1	-155.5
VPC 12.5k	161.925	AIS 1371	161.975	-23.2	8.2	22.0	-53.5	-132.6	-79.1
AIS 1371	161.975	VPC 12.5k	161.925	23.6	8.2	22.0	-6.7	-132.1	-125.4

Table 1.2 – VPC Radio on 12.5 kHz Channel vs. AIS 1371 Radio Transmitter Noise

Figure 1.0-1 Transmitter Noise Summary

2.1 Worst Case Example Transmitter Noise Example Calculation

The worst-case example of transmitter noise is from the transmitter (161.9625 MHz) in the transmit circuit in system 'VPC' to the receiver (161.975 MHz) in system 'AIS'. The transmitter noise margin value of -114.9 dB is calculated using the following method:



Step 1: Calculate transmitter noise at receiver's antenna.

F_{TX} = 161.9625 MHz	Transmit frequency
F_{RX} = 161.975 MHz	Receive frequency
BW_{RX} = 20 kHz	Receiver bandwidth
P_{TX} = 44.0 dBm	Transmitter power
PSD_{TX} = -80.0 dBc	Relative power emitted by trans. in receiver band (from transmitter's power spectral density curve)
$L_{TX\text{-}Ant}$ = 2.6 dB	Loss from transmitter to transmitter's antenna at F_{RX}
$L_{Ant\text{-}Ant}$ = 22.0 dB	Antenna (or coupler) isolation at F_{RX}
N_{TXC} = PSD_{TX} + 10 × log (BW_{RX}) = -80.0 + 10 × log (20000.0) = -37.0 dBc	Noise emitted by transmitter in receiver's band relative to carrier
N_{TX} = P_{TX} + (N_{TXC}) = 44.0 + (-37.0) = 7.0 dBm	Noise at transmitter in receiver's band
N_{Ant} = N_{TX} - ($L_{TX\text{-}Ant}$ + $L_{Ant\text{-}Ant}$) = 7.0 - (2.6 + 22.0) = -17.6 dBm	Transmitter noise at receiver's antenna

Step 2: **Calculate the susceptibility of the receiver at its antenna.**

$Sense_{RX}$ = -117.0 dBm — Receiver sensitivity

[C/N] = 18.0 dB — Equivalent carrier-to-noise level for specified receiver sensitivity

NF_{Ant-RX} = 0.5 dB — Equivalent noise figure of sector from antenna (or coupler) to receive input

N_{Site} = 3.6 dBkTB — Site noise from Site Noise curve relative to kTB

G_{Ant-RX} = -0.5 dB — Gain from antenna (or coupler) to receiver

kTB = — Thermal noise in the receiver bandwidth at room temperature.

$= -174.0 + 10 \times \log(BW_{RX})$

$= -174.0 + 10 \times \log(20000.0)$

$= -131.0$ dBm

NF_{RX} — Noise figure of receiver

$= Sense_{RX} - [C/N] - (kTB)$

$= -117.0 - 18.0 - (-131.0)$

$= -4.0$ dB

NF'_{Ant} — Noise factor at antenna

$= 10^{(NFAnt-RX)/10} + [(10^{(NFRX/10)}-1)/ 10^{(GAnt-RX/10)}]$

$= 10^{(0.5)/10} + [(10^{(-4.0/10)}-1)/ 10^{(-0.5/10)}]$

$= 0.4$

NF_{Ant} — Noise factor at antenna in decibels

$= 10 \times \log(NF'_{Ant})$

$= 10 \times \log(0.4)$

$= -3.5$ dB

NF_{SysAnt} — System noise figure at antenna adds external noise at the site to the internal noise at the antenna.

$= 10 \times \log(10^{(NFAnt / 10)} + 10^{(NSite / 10)})$

$= 10 \times \log(10^{(-3.5/10)} + 10^{(3.6/10)})$

$= 4.4$ dB

$S_{RX\ Ant}$ — Susceptibility of receiver to interference at receive antenna

$= kTB + NF_{SysAnt} - 6$

$= -131.0 + 4.4 - 6$

$= -132.6$ dBm

Step 3: Calculate the noise margin.

N_{Margin} — Margin between noise reaching receive antenna and level of susceptibility at antenna

$= S_{RX\ Ant} - N_{Ant}$

$= -132.6 - (-17.6)$

$= -114.9$ dB

3.0 Receiver Desensitization Analysis

Receiver desensitization is interference caused by transmitter signals coupling into a receiver and desensitizing the receiver. The leakage power is compared with the receiver's desensitization level. For this analysis, receiver desensitization level is defined as level that degrades the receiver sensitivity by 1 dB. A positive desensitization margin represents the margin before interference occurs. If the desensitization margin is negative, the amount represents the level of improvement in isolation required between the transmitter and receiver at the transmitter frequency. The system also accumulates the effects of all transmitters on a receiver at a site. Receiver Desensitization for this analysis did show scenarios where interference could be an issue. Due to the significant transmitter noise involved the Receiver Desensitization problem is secondary in nature and is not the primary concern.

The levels in figure 2.0-1 show the predicted worst-case receiver desensitization margin between the receivers and transmitters at the site.

TX System	TX (MHz)	RX System	RX (MHz)	P_{TX} (dBm)	L_{TX-Ant} (dB)	$L_{Ant-Ant}$ (dB)	L_{Ant-RX} (dB)	$P_{at\ RX}$ (dBm)	$D_{at\ RX}$ (dBm)	D_{Margin} (dB)
VPC 25k	161.9625	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-70.0	-90.7
AIS 1371	161.975	VPC 25k	161.9625	40.0	0.7	22.0	0.5	16.7	-50.0	-66.7
VPC 25k	161.95	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-20.0	-40.7
AIS 1371	161.975	VPC 25k	161.95	40.0	0.7	22.0	0.5	16.7	-5.0	-21.7
VPC 25k	161.9375	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	25.0	4.3
AIS 1371	161.975	VPC 25k	161.9375	40.0	0.7	22.0	0.5	16.7	25.0	8.3
VPC 25k	161.925	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	30.0	9.3
AIS 1371	161.975	VPC 25k	161.925	40.0	0.7	22.0	0.5	16.7	30.0	13.3

Table 3.1 – VPC Radio on 25 kHz Channel vs. AIS 1371 Radio Receiver Desensitization

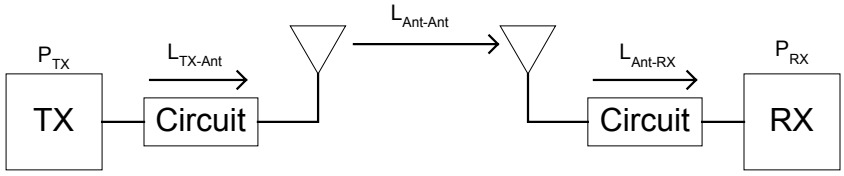
TX System	TX (MHz)	RX System	RX (MHz)	P_{TX} (dBm)	L_{TX-Ant} (dB)	$L_{Ant-Ant}$ (dB)	L_{Ant-RX} (dB)	$P_{at\ RX}$ (dBm)	$D_{at\ RX}$ (dBm)	D_{Margin} (dB)
VPC 12.5k	161.9625	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-70.0	-90.7
AIS 1371	161.975	VPC 12.5k	161.9625	40.0	0.7	22.0	0.5	16.7	5.0	-11.7
VPC 12.5k	161.95	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	-20.0	-40.7
AIS 1371	161.975	VPC 12.5k	161.95	40.0	0.7	22.0	0.5	16.7	30.0	13.3
VPC 12.5k	161.9375	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	25.0	4.3
AIS 1371	161.975	VPC 12.5k	161.9375	40.0	0.7	22.0	0.5	16.7	30.0	13.3
VPC 12.5k	161.925	AIS 1371	161.975	44.0	0.7	22.0	0.5	20.7	30.0	9.3
AIS 1371	161.975	VPC 12.5k	161.925	40.0	0.7	22.0	0.5	16.7	30.0	13.3

Table 3.2 – VPC Radio on 25 kHz Channel vs. AIS 1371 Radio Receiver Desensitization

Figure 2.0-1 Receiver Desensitization Summary

3.1 Worst Case Example Receiver Desensitization Example Calculation

The worst-case example of receiver desensitization is from the transmitter (161.9625 MHz) on transmitting circuit in system 'VPC' to the receiver (161.975 MHz) in system 'AIS 1371'.



Step 1: Calculate transmitter power at receiver.

F_{TX} = 161.9625 MHz	Transmit frequency
F_{RX} = 161.975 MHz	Receive frequency
BW_{RX} = 20 kHz	Receiver IF bandwidth (for 25 kHz channel)
P_{TX} = 44.0 dBm	Transmitter power
L_{TX-Ant} = 0.7 dB	Loss from transmitter to transmitter's antenna at F_{TX}
$L_{Ant-Ant}$ = 22.0 dB	Antenna (or coupler) isolation at F_{TX}
L_{Ant-RX} = 0.5 dB	Losses from receiver's antenna to receiver at F_{TX}
P_{RX} = P_{TX} - (L_{TX-Ant} + $L_{Ant-Ant}$ + L_{Ant-RX}) = 44.0 - (0.7 + 22.0 + 0.5) = 20.7 dBm	Power emitted by transmitter in transmitter's band reaching receiver

Step 2: Calculate desensitization margin at receiver.

$Desense_{RX}$ = -70.0 dBm	Desensitization level of receiver at F_{TX}. This value is derived from the LNA's power rejection mask curve.
$D_{RX\ Margin}$ = $Desense_{RX}$ - (P_{RX}) = -70.0 - (20.7) = -90.7 dB	Margin between desensitization level of the receiver and the transmitter power reaching the receiver

CERTIFICATE OF SERVICE

I, Susan F. Duarte, do hereby certify that on this 1st day of December, 2003, the foregoing Comments were served on the following persons by the method indicated:

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